Operational analysis of Korean defense expenditures

Won, Eunsang

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Eunsang Won

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

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of
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by

Eunsang Won

Thesis Advisor: Paul M. Carrick

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Eunsang Won
Captain, Republic of Korean Army
B. S., Korean Military Academy, 1966

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ABSTRACT

The huge size of the Korean defense budget and its armed forces have created a need for an operational analysis. It is shown through a multivariate statistical analysis what some of the opportunity costs of defense spending have been.

The Korea-U. S. alliance is discussed emphasizing developmental effects of U. S. aid.

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I. INTRODUCTION

This is a report about a central issue of Korean economics - expenditures for national defense. Korean military spending in 1970 reached a record 100 billion current Korean won; up 40 times since 1953 when The Bank of Korea compiled the first estimate of global military spending, based on National Income Statistics Yearbook. During this period, military outlays in current won have grown at the following rate; 2.5 billion won in 1953, 11 billion won in 1957, 20 billion won in 1962, 49 billion won in 1967, and 100 billion won in 1970.

Large armed forces have become a part of Korean life, as Korean as Kimchee.

Although it has the 22nd largest population among the world's people, Korea maintains the 6th largest armed forces on earth.

The arms race pattern of interaction between Korea and North Korea is widely regarded as the major reasons for Korean arms spending. Military expenditures provide a useful barometer of the momentum of the arms race. Figure I shows that the rate of expansion of defense expenditures was, by far, the sharpest for both sides during the last 8 years. North Korea spent 629 million dollars in 1968, while Korea spent 235 million dollars. Adding U. S. military assistance of 204 million dollars, the sum was still far below that of North Korea. This suggests that the Korean defense budgets might increase even more in the future.

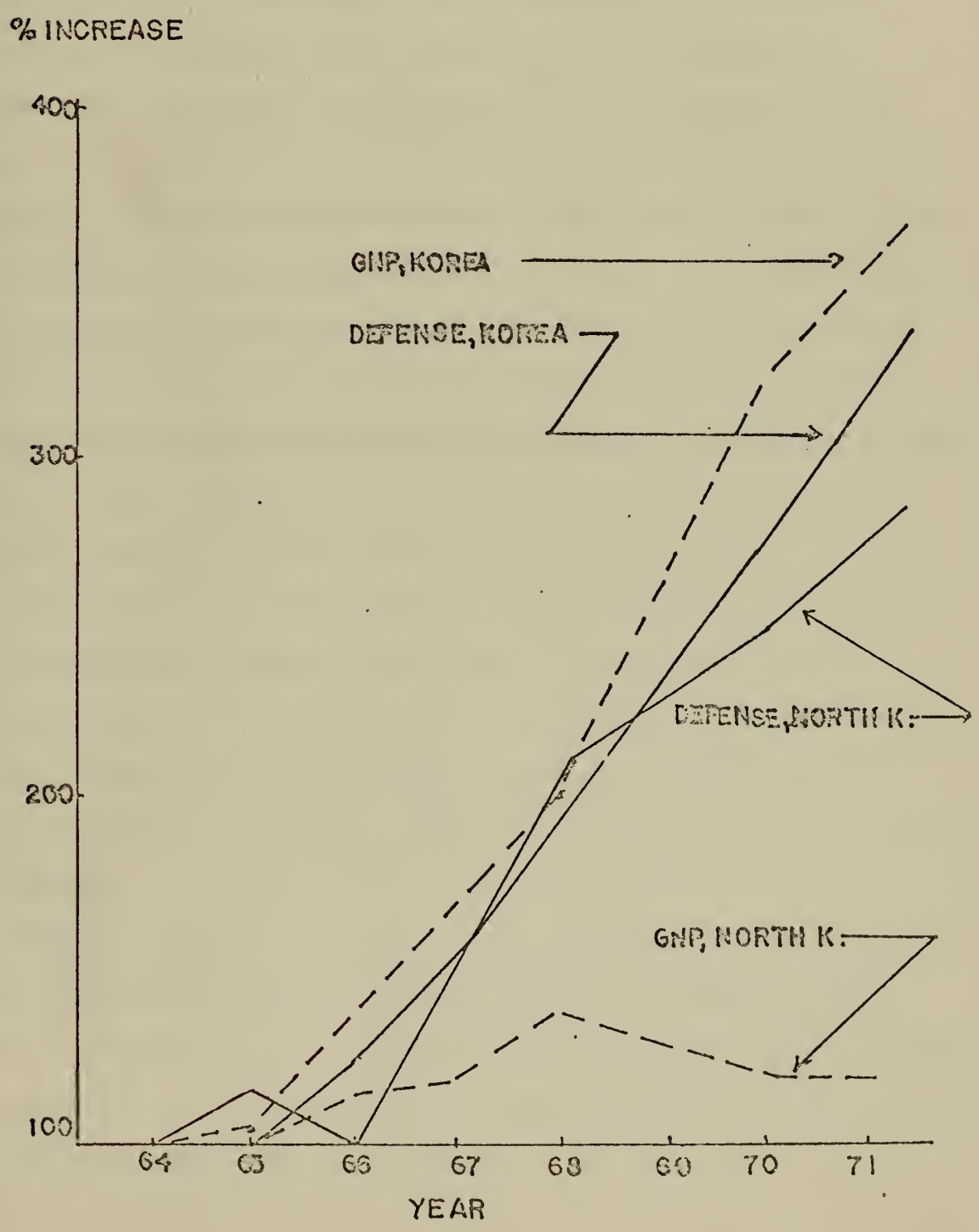
TABLE I
DEFENSE RELATED DATA FOR KOREA AND NORTH KOREA

Field	Year / Side	1964	1965	1966	1967	1968	1970	1971
Military Expenditures Current (US $ million)	N	300	350	300	460	628	746	849
	K	123	113	150	184	235	335	425
GNP Current Million US $	N	2,500	2,500	2,900	3,000	3,500	3,000	3,420
	K	2,745	2,901	3,822	4,612	5,730	8,300	10,200
Armed Forces (1000 men)	N	362	378	383	383	410	389	401
	K	600	604	572	612	620	597	634
Relative Defense (%) Burden	N	12.0	14.0	10.3	15.3	18.0	24.9	25.0
	K	4.5	5.6	3.9	4.0	4.1	4.0	4.0
Population (million)	N	11.8	12.0	12.3	12.5	13.0	13.9	14.0
	K	27.2	28.0	28.8	29.0	30.5	32.0	32.7

Above data was derived from the series of "Armed Forces of the World" by Robert C. Sellers.

FIGURE 1

MILITARY EXPENDITURES AND GNP ESTIMATE IN CONSTANT PRICES INDEX, 1964=100



It is reasonable to assume that defense spending has to come at the expense of something else. Alternatively,it is sometimes suggested that government expenditures such as defense, utilize resources that would otherwise be unemployed in the economy. This thesis will show which industry and factor of the economy are affected disproportionately from defense spending. Furthermore, it will enable us, in a sense, to do a cost benefit analysis of war or preparedness, and to identify the opportunity costs in the kind and amount of social benefits that are likely to be forgone. Thus the following assumptions are appropriate to precisely the kind of question relating to this study. If the civilian and military expenditures consistently compete for scarce resources, they will be highly negatively correlated. If they both are driven by the same factor, they will be positively correlated. If they generally compete but sometimes are viewed as complimentary, the negative correlation will be fairly low. By this criterion, one would hope to see periodic upswings in defense requirements financed largely out of personal consumption, with capital formation and such social investment in the public sector as health and education being insensitive to military demands. Another aspect of this criterion is the anticipation that in periods of declining military needs the released resources would be used for investment or education rather than returned to private consumption.

Fourteen sectors, or factors, of Korean economy, which are particularly concerned with military expenditures will be treated in this thesis. Various kinds of private and public expenditures were calculated as a proportion of GNP and these were then correlated with the proportion of GNP represented by defense spending.

Multivariate statistical methods were used. Further, statistical hypothesis testing methodology was used to determine if a strong relationship between the variables or between one variable and another set of variables existed. Partial correlation coefficients were compared with another set of correlation coefficients to see their dependence when the effect of another set of correlated variables has been removed. The next chapter, Chapter II, is a discussion of the opportunity costs of Korean defense. It is included to provide information on current and past research and to discuss some of the assumptions in the issues in defense economics relating to the model, in a specific application to the Korean defense. Chapter III contains a discussion of the economic value of alliances, since the Korean defense had a strong connection with U. S. The injection of 2.168 billion dollars of U.S. military assistance and the huge influx of U. S. economic aid, some 4.7 billion dollars, both over the period of 1946-1968, requires more analysis.

The final chapter contains a summary of this research effort and some suggested areas for future work.

II. THE BURDENS OF DEFENSE

In this chapter, the author shall examine information on expenditures by GNP categories, by function, and by governmental unit to see what kinds of alternative spending bear the brunt of military spending.

First, an overview of the changing level of defense expenditures in 1965 constant market prices may be helpful.[1] For 1953, in what was the Korean wartime year Korea has experienced, defense expenditures were over 39 billion won. After Korean War, they roughly decreased at the rate of 3.5% annually until they hit the minimum of 27 billion won in 1963. Defense expenditures started to rise rapidly, at the rate of 7.2% annually, after 1963. What an expenditure of this magnitude means, is clearer when it is measured against available economic resources. The value of Korean output had expanded at a fairly steady 5.1% annually until 1963. After 1963, during the period of First and Second Five-Year Economic Development Plan, Korea had a very rapid growth rate in GNP of 10.8% annually. The curve[2] which shows defense vs. year had the "V shape" with the minimum in 1963, while GNP had the property of monotonic increase over the whole time period. The reason for this relationship is that defense expenditures were decreasing until GNP reached 705 billion won in 1963. One other important property of defense expenditures during its decreasing

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[1] C. f. Table 1 and Table 2 in computer output for the following discussions.

[2] C.f. Variable 1 of Basic Data and Graph in computer output.

phase of the "V shape" (1953-1963) is that defense expenditures were decreasing absolutely in spite of the small rate of increase in GNP. This result can be viewed as due to a low priority within Korean economic development preference structure. When inspecting the graph of defense vs. GNP,[3] defense expenditures were decreasing slowly until they hit 27 billion won, and GNP and defense were both increasing rapidly after that turning point. What this means becomes clearer when the ratio of defense to the GNP vs. GNP was inspected.[4] The graph in this case, shows strictly decreasing relative burden of defense as a function of GNP. The relative burden of defense can be thought of as a price of defense to the nation as well as a demand for security, while GNP can be thought of as a level of income of the nation or its supply of resources. This graph suggests that when GNP was low, the nation suffered a heavy burden from defense spending,but a relatively lesser burden when GNP increased. It also shows that the relative demand for defense was inelastic. In discussing the defense burden the relative burden of defense expenditures as percentage of GNP is the most meaningful indicator. Looking at the graph[5] which represents the yearly change in the ratio of defense to GNP, it suggests that before 1963, the ratio sharply decreased, while its decrease slowed down after 1963.

This means that the reordering of the nations resource allocation took place and defense expenditures were being emphasized at the expense

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[3] C.f. See that graph in computer output.

[4] C.f. the graph next to the graph of defense vs. GNP in computer output.

[5] C.f. the graph in computer output.

of other sectors of the economy. The correlation coefficient between defense and GNP was 0.5652 which was statistically significant at 5% level, while that between the ratio of defense to GNP and GNP was -0.7716 which was also statistically significant.[6] Therefore, these facts suggest that Korea did not suffer a heavy rise in defense expenditures in terms of relative burden of defense, although the amount of defense spending increased in terms of won.

The most commonly used indicator for the purpose of relative burden of military expenditures, the ratio of military spending to GNP, is inadequate if used alone, and may be misleading. A major weakness of this ratio is that it fails to take account of the level of economic strength as represented by per capita incomes.

According to the Almanac of World Military Power in 1971,[7] the estimated GNP of Korea was about 8.3 billion dollars, while the GNP of North Korea was 3.4 billion dollars. The relative burden of defense was 4% for Korea and 25% for North Korea. The per capita GNP for Korea was 254 dollars, while that of North Korea was 243 dollars in 1971. Both Korea and North Korea fell into the category of high spenders for military purposes in terms of relative burden of defense and per capita GNP among all the countries in the world.[8]

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[6] C.f. the correlation matrix in computer output. All the statistical tests on this thesis hereafter was based on 5% significance level.

[7] Col. T. N. Dupuy, "The Almanac of World Military Power," pp. 257-274

[8] Gerald C. Smith, "World Military Expenditures, 1970," United States Arms Control and Disarmament Agency, pp. 8.

Changes in GNP are the major explanatory factor for all variables except foreign aid. GNP had an almost linear relationships with the other variables except for defense expenditures which is nonlinear.

In chapter I, the author discussed the choice of variables which were alternative opportunities to military expenditures. To see the validity of the selections of variables, multiple correlation coefficients of various combinations were calculated and tested in Table II.

The test of hypotheses about multiple correlation coefficients suggest that military expenditures were highly correlated with all of the other set of variables.

The relationship between GNP and defense expenditures is of major interest in this thesis. The correlation coefficient between them was 0.5652. What interpretation is to be given to the apparent positive relationship between them?

Does high GNP tend to cause high defense expenditures or is high GNP associated with high defense expenditures? To answer this question, it is useful to consider the correlation between them while holding all other variables fixed; i.e., the partial correlation coefficient. If the effect of all other governmental expenditures is removed, GNP and defense are negatively correlated, i.e., $r_{1,2.3} = -0.4828$. The same effect results when holding investment effect fixed. When the effect of foreign aid was removed, the relationship between GNP and defense decreased, i.e., $r_{1,2.9} = 0.4413$. This suggests that foreign aid increased the relationship between GNP and defense.

TABLE II

MULTIPLE CORRELATION COEFFICIENT

MULTIPLE CORRELATION COEFFICIENT	BASIC	COMPOS
R1•2, 3, ..., 15	0.99209	0.99964
R1•12, 13, 14, 15	0.93860	0.99435
R1•2, 3, 4, 5	0.93286	0.97600
R2•4, 5, 7	0.99906	0.97605
R1•2, 7	0.96603	0.97314
R1•3,9	0.64333	0.94326
R2•5, 9	0.97304	0.94231
R2•10, 11	0.96809	0.97803

All the elements with significance at $\alpha = 0.05$ level i.e., for all the multiple correlation coefficient the hypothesis that there is no relationship between variables were rejected at the 5% of significance level.

Next to defense, the largest single outlay that government makes is for education as shown in Table I in computer output. Like the military budget, educational expenditures increased very rapidly during the last 18 years, 6.6% annually. However, it was still less than half of defense expenditures. Considering the rapid growth of the school-age population, expenditures for education was not much appreciably per pupil. The number of pupils at primary school was 5.55 million[9] in 1969. This indicates Korean expenditures for public education was less than 3,600 won (less than 10 dollars) per primary school child, assuming all funds go to primary schools. The correlation coefficient between defense and education was 0.4023 which was statistically insignificant at 5% level and it was 0.3967 when both were measured in terms of the ratio to GNP. For both cases education had weak relationship between defense, but nonetheless important. A widespread assumption holds that public expenditures on education have experienced a long-term secular growth in Korea. That assumption is correct only with modifications. The proportion of GNP devoted to public education has roughly increased until 1962, but rapidly decreased thereafter from 2.0% in 1962 to 1.5% in 1970. One interesting fact is that this decreasing part coincides with that of rapidly increasing part of defense expenditures. This fact supports the results that the reordering of resource allocation took place at that time. Public expenditures for education seemed to be insensitive to the pressures of defense, since the correlation coefficients between them were as low as 0.4023. However, if the effect of GNP or government expenditures was removed, then defense and education

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[9] Economic Planning Board, "The System of Korean Government" Pamphlet-1, 1970, Table 23, "The increase rate of pupils and teachers."

competed for limited resources, i. e., $r_{1,14.2} = -0.902$ and $r_{1,14\cdot3} = -0.7602$. Thus the sensitivity of educational expenditures to military need is much more marked in terms of partial correlation coefficients.

For all publicly supported health care, the Korean government paid out an estimated 1.05 billion won in 1970, or one-fiftieth as much as defense spending. For all Koreans, this amount spent for health care averaged out to almost nothing. The simple correlation coefficient between defense and health care was 0.5985 which was significant. However, the correlation coefficient in terms of the ratio to GNP between them was -0.8062. Thus public health care was more sensitive to the pressures of defense than education. This can be interpreted to suggest that education was preferred to public health care in Korea. Accordingly, it seems fair to conclude from the above, that increasing defense spending has hampered the nation in its attempt to build a healthier citizenry.

The correlation coefficient between recreation and defense was -0.9558, in terms of ratio to GNP. It suggests that Korea did not give much attention to this side, and that expenditures for recreation were the least preferred among all the sectors of Korean economy.

Korean armed forces were estimated at about 634,400 men in 1971. The ratio of armed forces to population was 2%. When compared with the economically active male population, in 1971, the level of armed forces was really significant, one man out of every 10 economically active men.

A nation's international balance of payments is often a major casualty of sharp increases in military expenditures; the Korean situation is not unusual. Some potential exports are diverted to

satisfy internal demand. Others are lost because domestic inflation raises costs to the point that the goods are priced out of the world market. In 1970, Korea imported 540 billion won worth of goods, while exporting 228 billion worth of goods. Over the period of this survey, the correlation between them was 0.9803, which was statistically significant. The correlation coefficient between defense and export was 0.7230, while 0.7427 for import; both were statistically significant. This suggests that Korean defense depends on foreign exchange, especially in imports.

The correlation between private consumption expenditures and defense expenditures was highly positive. This suggests that both were increased by the same factor, GNP. Private consumption has indeed been the largest alternative use of defense money. This fact can be explained using partial correlationships. Thus, $r_{14} = 0.5131$, $r_{14.2} = -0.7526$, $r_{14.3} = -0.7376$, $r_{14.9} = 0.3634$. These relationships mean that for fixed GNP or fixed government expenditures, the defense was really competing with private consumption expenditures. The effect of foreign aid turned out to be crucial, in the sense that foreign aid smoothed the competition between defense and private consumption expenditures. The defense expendutures roughly decreased at the rate of 3.5% annually from 1953 to 1963. During that time, private consumption expenditures increased 5% annually. Considering the ratio to GNP, it was the most inelastic among any sectors of the economy, but it roughly decreased annually.

The correlation coefficient between defense spending and investment, in terms of percentage of GNP was -0.5423. What it means is that Korea continued to shift more money to investment from defense spending. When compared with private consumption expenditures, the correlation was -0.9170, in terms of percentage of GNP. Furthermore, when inspecting the data and the correlation matrix in the computer output, the investment was highly negatively correlated with government expenditures, education, as well as private consumption and defense expenditures in terms of percentage of GNP. One more important fact is that investment was the only factor which increases yearly, in terms of a percent of GNP among those above. Combining those results, it can be concluded that investment was the most preferred sector of Korean economy.

The level of government expenditures defines the level of requisite tax burden. In this context, increase in defense expenditures caused an increase in taxation, thus the highly positive correlation between government expenditures and defense resulted. Expanded defense needs are usually financed by a combination of increased taxation and deficit spending. Bank notes and coin issued in each year during the last ten years, were approximately the same amount as the defense expenditures.[10] The high level of government expenditures appears to be the prime reason for inflation. Multiple regression coefficients show the joint relationship of defense to a set of variables of GNP, government expenditures, private expenditures and investment.[11] This suggests that defense

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[10] The Bank of Korea, "Economics Statistics Yearbook 1971," pp. 92, the correlation coefficient between them was 0.955.

[11] C.f. the last page of computer output.

expenditures can be predicted as a linear combination of the above four variables. Thus the increase in one dollar for each sector is associated with changes in defense expenditures as follows; 10 cents for GNP, 64 cents for government expenditures, -19 cents for private consumption expenditures, -1 cent for investment. The result can be written as a regression equation;

$$\text{Defense Expenditures} = 26.5 + 0.1\,(\text{GNP}) + .64\,(\text{Government Expenditures}) - .19\,(\text{Private Consumption Expenditures}) - .01\,(\text{Investment}).$$

This completes the development of the model required to describe the burden of defense.

III. THE ECONOMIC VALUE OF ALLIANCES

The Korea-U. S. Alliance can be thought of as a collective good. The U.S. extends an umbrella to cover Korea from communist attack, and at the same time, augments its own forces by the extent of the Korean defense effort. After the Korean War, the number of U. S. troops in Korea remained roughly the same. From 1954 until 1970 there were two divisions of varying strength. Today, operational control of all the Korean troops is exercised by the Commanding General, U. S. Eighth Army, who concurrently holds the post of Commander of the U. S. Forces in Korea. In a military alliance, the collective good aspect remains important. The small country will feel able to relax its own efforts, because it has obtained the protection of a great power. The U. S. may indeed want to limit the credibility of its assurances, since they carry a risk of involvement in a major war for the sake of Korean objectives, that may be trivial for the U.S.

The U. S. commitment to the defense of Korea was formally embodied in the 1954 Mutual Defense Agreement and in repeated assurances by various presidents and through numerous U. S. officials. The treaty, however does not commit either country to go to war if the other is invaded, but seeks to provide a less firm commitment. This obscurity may give some confidence to North Korea and some doubt to Korea. Moreover, the U. S. withdrew one division in 1971, and again withdrew the lone U. S. Division guarding the 18 mile stretch of the D. M. Z. and turned the defense of the entire 155 mile boundary over to the Korean Army. The U. S. now has the additional time to decide whether or not to

commit its ground forces after the start of hostilities. Consequently, withdrawals of these kinds increased the doubt over the U. S. commitment and stimulated the defense budget of Korea in 1971.[12]

Senator George McGovern stated "Asia is seen as having only a marginal bearing on vital American interests."[13] In spite of 157,530 lives and about 5 billion dollars which had already gone to Korea, the U. S. still intends retrenchment in its foreign affairs with regard to Korea.

As Olson and Zechauser pointed out, it is reasonable to assume that the larger the nation, the more disproportionate the share of the total military cost it will bear, and the failure of burden sharing would thus indicate the success of deterrence. In reality, the deterrence provided in the Defense Treaty, successfully aided Korea in achieving two Five-Year Economic Development Plans without large defense expenditures.

Regrettably, many countries must strive to make economic and social progress while carrying a heavy burden of defense, and military needs compete with development projects for limited resources.

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[12] The defense budget in 1971 was 134 billion won in current prices which was 27.2% increase from 1970.

[13] U. S. Senator George McGovern "Toward a More Secure America - an Alternative National Defense Posture", pp. 24.

Looking at Figure II, U. S. military assistance as a percent of Korean military expenditureswas 282% in 1958 and 122% in 1967, averaging 180% over 13 years.[14] How can Korea maintain a large military establishment and at the same time, finance rapid developments without U. S. aid?

To make measurements of the military burden of the Korean economy, it is necessary to evaluate the U. S. aid.

Did military assistance have developmental effects? The answer turns primarily upon whether the Korean government resources and U. S. aid were tangible, and what would have been the reactions of the Korean government to a withdrawal of military budget support. Given a resource constraint, if the Korean government had raised taxes to make up part of the loss which might come from elimination of military assistance, it is likely that a major part of these taxes would have reduced private savings and investment. In these circumstances, the primary effect of military budget support, was to make available more Korean resources for development.

The correlation coefficient between defense expenditures and foreign aid was -0.3950. This suggests that high defense spending was associated with low foreign aid and the correlation was statistically not significant. Partial correlation coefficients were as follows; $r_{19.2} = 0.014$, $r_{19.3} = 0.027$, $r_{19.5} = 0.149$. These suggest that, for fixed GNP or government expenditures or investment, defense expenditures were independent of foreign aid. Foreign aid was negatively correlated with GNP with coefficient -0.7134. Furthermore, this fact can be interpreted to suggest that increases in GNP lead to decreases in foreign aid after 1957.

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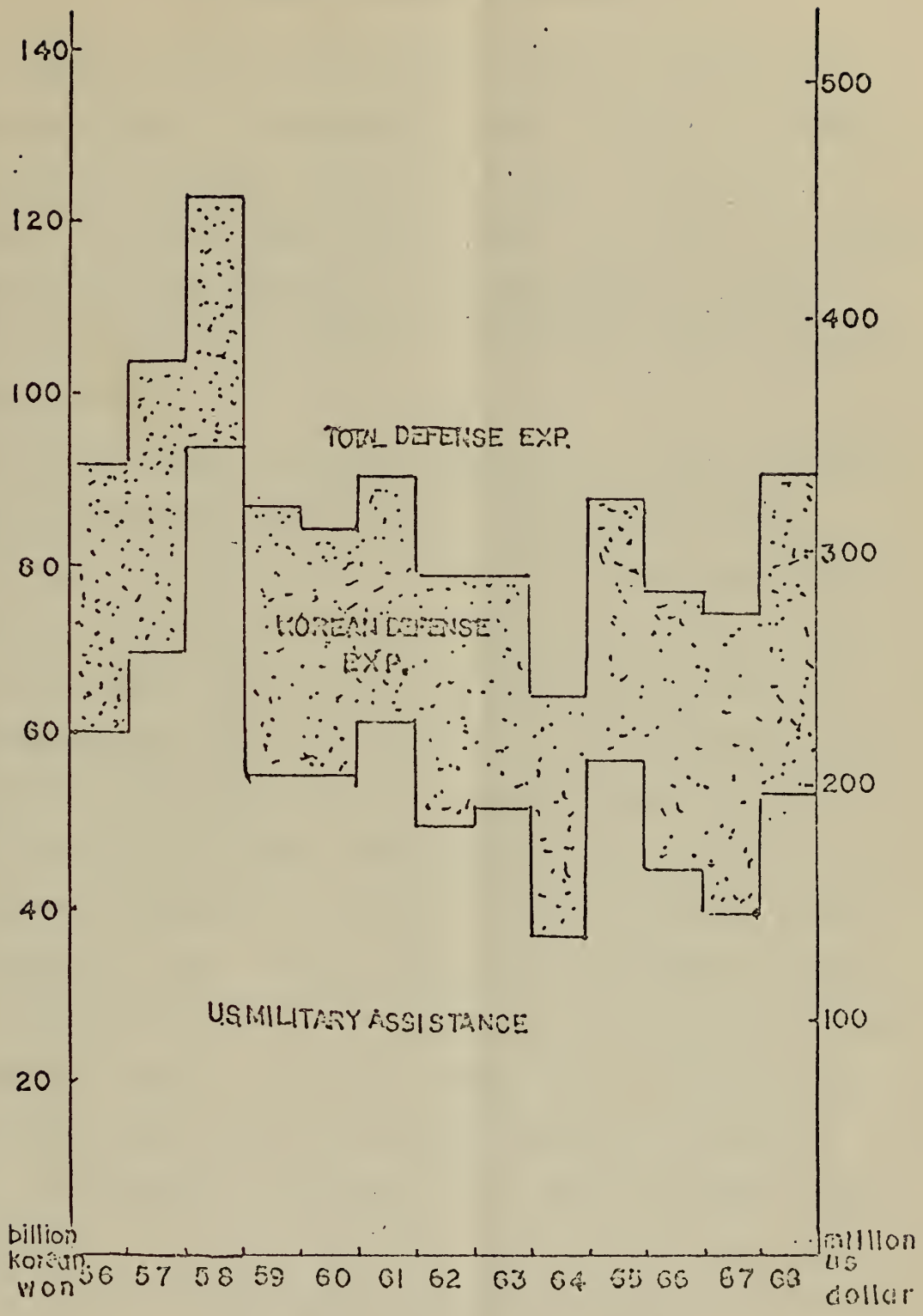
[14] Correlation coefficient between defense and military assistance was 0.226, regression coefficient was 0.048 for simple regression.

FIGURE II

MILITARY ASSISTANCE



IN 1965 CONSTANT MARKET PRICES
(1 US DOLLAR = 272.60 KOREAN WON)

IV. SUMMARY AND AREAS FOR FURTHER STUDY

In summary, it has been shown that the burden of defense can be interpreted in terms of the opportunity costs of the kind and amount of social benefits that are likely to be forgone. In large part, the burden of a big defense budget has been thrust onto Korea by the demands of the arms race with North Korea. Past fluctuations in defense and civilian need indicate what some of the opportunity costs of defense spending have been.

The Korean economic standard of living, in real terms, has shown a significant improvement during the past 8 years, after the Third Republic began. The diversion of resources to military purposes has expanded in accordance wih the Korean capacity to produce after 1963.

On the requirement that defense upswings be financed largely out of private consumption as well as sacrificing public expenditures for education and health care, part of the growth dividend since 1963 has been dissipated in higher defense expenditures, rather than contributing to the improvement of the nation's welfare. However, in spite of increasing per capita defense expenditures, the burden of defense has been reduced during the entire period of study, since GNP per capita increased more rapidly. One result, however, is that in that period of declining military needs, the released resources be allocated largely for consumption and education first, and then switched largely for investment. It suggests that educational needs apparently could not be sacrificed or postponed when military needs were great, although the amount of expenditures was far less than that of defense purposes.

During the entire period of survey, investment's share of the GNP was the only factor which was continuously rising among the sectors of the economy. Combining with continuously decreasing relative defense spending, this drop in relative defense spending has perhaps enabled investment to rise. In the long run, a nation's strength depends on a continuing high level of investment. In this sense, Korean economic policy achieved great success in concentrating its efforts on investment, rather than for defense, so that Korea has become the model case for developing countries.

Alliances in the form of U. S. military and economic aid, not only proved successful in its deterrence effect, but also provided a means for allowing Korea to make available more resources for development projects.

There are several areas which seem suitable for further study. First, statistical estimation procedures should be applied within a linear regression model and indicate the amount in dollars by which an item of civilian spending changes in response to a one-dollar increase or decrease in defense. Second, defense expenditures are not necessarily without social utility. The positive effects of military establishment were not discussed here. These effects could be developed further, as well as the social value of defense. A third area for study is the regional impact of military spending. This area needs a higher degree of data and more information about the geographical distribution of the military establishment. Finally, the model could be extended to more detailed subcategories of the economy. This would involve some method of classifying the sectors of Korean economy.

Past opportunity costs in Korea do not provide a perfect guide or deterministic mold for the future. Both the political system and the economy change. Should it be concluded, after enlightened discussion, that certain new defense needs must be met, it is possible, by careful choice and control, to distribute the burden of defense somewhat differently.

APPENDIX

MULTIVARIATE STATISTICAL ANALYSIS TO THE DEFENSE EXPENDITURES

The mathematical model on which this analysis is based is multivariate Normal distribution or a combination of multivariate Normal distributions. The main justification for studying methods relating to the Normal distribution so intensively, is that this mathematical model is suitable for such a large number of cases, when multiple measurements are treated.

In this case, as well as a host of others in econometrics, the multivariate Normal distributions have been found to be sufficiently close approximations to the true population, so that statistical analysis based on these models are justified. Another reason for confining this study to considerations of Normal theory is that multivariate methods based on the Normal distribution are extensively developed, and can be studied in a rather organized and systematic way.

The Basic Data[15] is a rectangular matrix denoted "A". It is composed of 270 elements. That is, 18 observation for every 15 variables.

$$A = (a_{ij}), \quad \begin{matrix} i = 1, 2, \ldots, 18 \\ j = 1, 2, \ldots, 15 \end{matrix}$$

Each column represents the variables which are indexed by j, j = 1, 2, ..., 15 as follows:

1. defense expenditures
2. GNP
3. government consumption expenditures
4. private consumption expenditures

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[15] All the data and statitical analysis appeared in computer output.

5. total investment
6. wholesale price index, 1965=100
7. population in millions
8. exchange rate of Korean won to U. S. dollars
9. foreign aid
10. export
11. import
12. public administration and defense products
13. recreation and entertainment
14. education
15. sanitary services

All the data, except for population and foreign aid, came from "National Income Statistics Yearbook 1971" by The Bank Of Korea, and population and foreign aid came from "Economic Statistics Yearbook 1971" by The Bank of Korea.

All amounts were measured in billion Korean won of the 1965 constant market value, except for variables 6, 7 and 8. Variables 1 and 3 were adjusted to constant market prices in 1965 as follows:

$$\text{amount in constant market prices in 1965} = \frac{\text{amount at current market prices}}{\text{price deflator for government spending}}$$

Variables 9, 10 and 11 were adjusted as follows:

$$\text{amount in constant market prices in 1965} = \text{Amount in dollars} \times \text{exchange ratio in } {}_{1965}$$

This calculation assumed that the value of U. S. dollars changed insignificantly, when compared with change in won value.

Each row number represents the corresponding year which is indexed by i, i = 1, 2, ..., 18

Year = row index + 52

e.g. For 1st row: 1 + 52 = 53, i.e., the data in 1953.

Therefore, this survey covered the period of 18 years, from 1953 to 1970.

The Composition Data is a rectangular matrix denoted "B". It is composed of 270 elements, and it was derived as follows:

$$b_{ij} = \frac{a_{ij}}{a_{i2}} \times 100 , \qquad \begin{matrix} i = 1, 2, \ldots, 18 \\ j = 1, 2, \ldots 6, 15, \; j \neq 2, 6, 7, 8. \end{matrix}$$

$$B = (b_{ij}) , \qquad \begin{matrix} i = 1, 2, \ldots, 18 \\ j = 1, 2, \ldots, 15 \end{matrix}$$

Since the variables 2, 6, 7 and 8 were not transformed, they are the same numbers as those in Basic Data. The method of maximum likelihood was used to a large extent, since it leads to reasonable procedures, and it gives unbiased estimates of some important parameters.

First, to see how much Korea had spent for some variables during the last 18 years, the total sum of the amounts were calculated. In statistics, central value refers to the location of the center of the distribution and it gives the general behavior of some variables. This is shown next to the sums in computer output.

The cross-product deviations, variance-covariance matrix, and the standard deviations of each variable was shown, to see how the observations were spread out from the average.

The purpose of this analysis, is to predict the dependence between variables. The notion of correlation coefficient was expanded to multiple correlation and partial correlation, to see the dependence between one variable and another set of variables, and the dependence

when the effect of other correlated variables have been removed, respectively. Cross-tabulation plots of any two variables were scaled to 50x100 character spaces or units, by computer, to identify how two variables were related to each other visibly.

Null hypothesis about the simple correlation coefficient, was that a pair of variables were not correlated. To test this hypothesis, t - statistics were used with significance level of 5% and power of test as 90%. The confidence interval for this test was (-0.4683, 0.4683). Null hypothesis about the multiple correlation coefficient, was that there is no relationship between one variable and another set of variables. To test this hypothesis, F - statistics were used with significance level of 5% and power of test as 90%. Multiple regression shows the joint relationship of defense expenditures to a set of variables of GNP, government expenditures, private expenditures and investment. T values were computed and tested for 99.9% of confidence interval. All the t - values were accepted. F value was computed and tested for the independence of denominator and numerator. This test resulted in a significant deviation from regression at 5% of significance level.

1. BASIC DATA

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	39.68	421.93	60.14	361.79	69.56	12.00	20.20	18.00	52.88	10.79	94.15	46.56	0.08	7.51	0.12
2.	37.22	447.36	58.81	381.05	57.87	15.40	20.80	18.00	41.71	6.60	66.32	43.52	0.24	8.95	0.10
3.	33.52	474.54	61.09	422.89	61.34	27.80	21.40	50.00	64.33	4.91	93.07	43.03	0.38	9.91	0.11
4.	31.14	480.47	65.73	444.85	57.29	36.60	22.30	50.00	89.14	6.70	105.25	41.58	0.59	10.51	0.17
5.	34.13	552.73	66.34	471.32	87.91	42.50	22.90	50.00	104.41	6.05	120.54	39.52	0.79	10.82	0.17
6.	33.48	551.69	70.52	486.05	77.72	39.90	23.60	50.00	87.50	4.50	103.10	37.06	1.16	11.04	0.18
7.	31.11	575.84	69.84	508.55	57.83	40.80	24.30	50.00	60.52	5.40	82.82	36.48	1.56	11.32	0.19
8.	28.64	589.07	71.13	523.30	62.48	45.20	25.00	65.00	66.79	8.94	93.64	36.06	1.60	11.60	0.30
9.	28.26	613.61	69.84	528.33	72.95	51.20	25.70	130.00	54.25	11.15	86.17	35.70	1.70	12.22	0.28
10.	29.06	634.97	70.44	568.96	77.99	56.00	26.40	130.00	63.24	14.94	114.98	36.96	2.39	12.88	0.31
11.	27.13	693.03	73.84	587.74	137.27	67.50	27.20	130.00	58.88	23.66	152.74	38.24	3.01	13.98	0.32
12.	28.17	750.31	71.18	620.44	114.41	90.90	27.90	256.50	40.62	32.67	110.24	38.88	3.40	14.76	0.32
13.	29.71	805.85	76.02	669.08	118.48	100.00	28.70	272.60	35.71	47.73	126.32	39.94	4.18	15.81	0.41
14.	32.35	913.82	84.76	716.99	207.38	108.80	29.40	271.50	28.08	68.23	195.29	42.21	4.49	17.16	0.34
15.	34.50	995.16	93.42	783.92	241.72	115.80	30.00	274.60	26.44	87.29	271.56	45.78	5.20	18.00	0.63
16.	38.48	1127.32	105.64	873.58	344.12	125.20	30.70	281.50	28.90	124.14	398.79	48.23	5.70	19.20	0.71
17.	43.61	1306.19	118.53	969.91	451.47	133.70	31.40	304.40	29.17	169.69	497.11	50.25	6.39	20.40	0.92
18.	44.89	1422.33	126.48	1077.16	433.94	145.90	32.00	316.60	22.35	227.68	540.84	52.65	7.03	21.87	1.05

2. COMPOSITION TO GNP IN % EXCEPT FOR VARIABLES 2,6,7,8

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1.	9.404	421.930	14.254	85.746	16.486	12.000	20.200	18.000	12.533	2.557	22.314	11.035	0.019	1.780	0.028
2.	8.320	447.360	13.146	85.177	12.936	15.400	20.800	18.000	9.324	1.475	14.825	9.728	0.054	2.001	0.022
3.	7.064	474.540	12.874	89.116	12.926	27.800	21.400	50.000	13.556	1.035	19.613	9.068	0.080	2.088	0.023
4.	6.481	480.470	13.680	92.586	11.924	36.600	22.300	50.000	18.553	1.394	21.906	8.654	0.123	2.187	0.035
5.	6.175	552.730	12.002	85.271	15.905	42.500	22.900	50.000	18.890	1.095	21.808	7.150	0.143	1.958	0.031
6.	6.069	551.690	12.783	88.102	14.088	39.900	23.600	50.000	15.860	0.816	18.688	6.718	0.210	2.001	0.033
7.	5.403	575.840	12.128	88.314	10.043	40.800	24.300	50.000	10.510	0.938	14.382	6.335	0.271	1.966	0.033
8.	4.862	589.070	12.075	88.835	10.607	45.200	25.000	65.000	11.338	1.518	15.896	6.122	0.272	1.969	0.051
9.	4.606	613.610	11.382	86.102	11.889	51.200	25.700	130.000	8.841	1.817	14.043	5.818	0.277	1.991	0.046
10.	4.577	634.970	11.093	89.604	12.282	56.000	26.400	130.000	9.960	2.353	18.108	5.821	0.376	2.028	0.049
11.	3.915	693.030	10.655	84.807	19.807	67.500	27.200	130.000	8.496	3.414	22.039	5.518	0.434	2.017	0.046
12.	3.754	750.310	9.487	82.691	15.248	90.900	27.900	256.500	5.414	4.354	14.693	5.182	0.453	1.967	0.043
13.	3.687	805.850	9.434	83.028	14.702	100.000	28.700	272.600	4.431	5.923	15.675	4.956	0.519	1.962	0.051
14.	3.540	913.820	9.275	78.461	22.694	108.800	29.400	271.500	3.073	7.466	21.371	4.619	0.491	1.878	0.037
15.	3.467	995.160	9.387	78.773	24.290	115.800	30.000	274.600	2.657	8.771	27.288	4.600	0.523	1.809	0.063
16.	3.413	1127.320	9.371	77.492	30.525	125.200	30.700	281.500	2.564	11.012	35.375	4.278	0.506	1.703	0.063
17.	3.339	1306.190	9.074	74.255	34.564	133.700	31.400	304.400	2.233	12.991	38.058	3.847	0.489	1.562	0.070
18.	3.156	1422.330	8.892	75.732	30.509	145.900	32.000	316.600	1.571	16.008	38.025	3.702	0.494	1.538	0.074

BMD02D CORRELATION WITH TRANSGENERATION - REVISED JANUARY 29, 1970
HEALTH SCIENCES COMPUTING FACILITY, UCLA

PROBLEM CODE BMD02D
NUMBER OF VARIABLES 15
NUMBER OF CASES 18

VARIABLE FORMAT CARD (S)
(8F10.2)

REMAINING SAMPLE SIZE= 16 , BASIC DATA

SUMS

605.0789	13356.1953	1413.7460	10995.8828	2731.7290	1255.1992	469.8994	2718.6995
954.9185	861.0696	3252.9280	752.6489	49.8900	247.9399	6.6300	

MEANS

33.6155	742.0107	78.5415	610.8823	151.7627	69.7333	26.1055	151.0388
53.0510	47.8372	180.7162	41.8138	2.7717	13.7744	0.3683	

CROSS PRODUCT DEVIATIONS

ROW	COL. 1	COL. 2	COL. 3	COL. 4	COL. 5	COL. 6	COL. 7	COL. 8
1	476.6790	15163.9141	1145.3555	9373.1914	8369.6484	1426.6936	78.4760	2903.2283
2	15163.9141	1509960.0000	98581.5000	1024779.6875	642109.5625	207482.2500	17727.0586	519558.3125
3	1145.3555	98581.5000	6656.0977	66783.0625	43125.2305	12987.5273	1100.8245	31252.9922
4	9373.1914	1024779.6875	66783.0625	709008.9375	429143.2500	142177.0000	12292.3789	355957.2500
5	8369.6484	642109.5625	43125.2305	429143.2500	291030.6250	83983.5000	6935.5586	204335.4375
6	1426.6936	207482.2500	12987.5273	142177.0000	83983.5000	30731.3438	2662.1611	79985.8750
7	78.4760	17727.0586	1100.8245	12292.3789	6935.5586	2662.1611	241.9920	6955.3359
8	2903.2283	519558.3125	31252.9922	355957.2500	204335.4375	79985.8750	6955.3359	218800.6875
9	-847.1189	-86111.3750	-5119.6211	-57175.8516	-35246.4961	-12392.2773	-1071.5232	-35834.3867
10	4228.8047	318680.3750	21373.6289	214054.2500	140888.3750	41355.9141	3386.1484	101252.3125
11	9844.6250	709861.1250	48611.0781	476028.4375	323994.8750	90409.5625	7400.5625	214013.0625
12	418.8862	17831.0000	1243.7710	11348.4609	9137.8281	2078.0383	135.1265	5019.8984
13	83.6488	11118.7734	703.6287	7611.9219	4547.7930	1609.0923	140.9526	4155.3125
14	149.9795	20545.0039	1306.5935	14091.2500	8404.6953	2971.7944	259.3340	7598.1797
15	15.0340	1383.2144	92.3360	941.2070	594.9241	184.0681	15.7873	452.8689

ROW	COL. 9	COL. 10	COL. 11	COL. 12	COL. 13	COL. 14	COL. 15	COL.
1	-847.1189	4228.8047	9844.6250	418.8862	83.6488	149.9795	15.0340	
2	-86111.3750	318680.3750	709861.1250	17831.0000	11118.7734	20545.0039	1383.2144	
3	-5119.6211	21373.6289	48611.0781	1243.7710	703.6287	1306.5935	92.3360	
4	-57175.8516	214054.2500	476028.4375	11348.4609	7611.9219	14091.2500	941.2070	
5	-35246.4961	140888.3750	323994.8750	9137.8281	4547.7930	8404.6953	594.9241	
6	-12392.2773	41355.9141	90409.5625	2078.0383	1609.0923	2971.7944	184.0681	
7	-1071.5232	3386.1484	7400.5625	135.1265	140.9526	259.3340	15.7873	
8	-35834.3867	101252.3125	214013.0625	5019.8984	4155.3125	7598.1797	452.8689	
9	9649.5430	-18148.0703	-35878.5234	-1228.5510	-690.3916	-1191.8657	-75.6436	
10	-18148.0703	71774.9375	159433.1250	4609.2734	2243.6299	4141.2266	298.8770	
11	-35878.5234	159433.1250	368552.0000	10477.8516	4923.2969	9146.7852	672.3364	
12	-1228.5510	4609.2734	10477.8516	447.8657	114.7601	206.4176	17.1096	
13	-690.3916	2243.6299	4923.2969	114.7601	85.8790	157.1793	10.0109	
14	-1191.8657	4141.2266	9146.7852	206.4176	157.1793	291.6311	18.4370	
15	-75.6436	298.8770	672.3364	17.1096	10.0109	18.4370	1.3236	

STANDARD DEVIATIONS

5.2953	298.0288	19.7872	202.9342	130.8413	42.5174	3.7729	113.4488
23.8248	64.9773	147.2597	5.1327	2.2476	4.1418	0.2790	

VARIANCE-COVARIANCE MATRIX FOR BASIC DATA

ROW	COL. 1	COL. 2	COL. 3	COL. 4	COL. 5	COL. 6	COL. 7	COL. 8
1	28.0399	891.9949	67.3738	551.3640	492.3320	83.9231	4.6162	170.7781
2	891.9949	88821.1250	5798.9102	60281.1563	37771.1484	12204.8359	1042.7681	30562.2500
3	67.3738	5798.9102	391.5352	3928.4153	2536.7781	763.9722	64.7544	1838.4111
4	551.3640	60281.1563	3928.4153	41182.2891	25243.7188	8363.3516	723.0811	20938.6602
5	492.3320	37771.1484	2536.7781	25243.7188	17119.4453	4940.2031	407.9739	12019.7305
6	83.9231	12204.8359	763.9722	8363.3516	4940.2031	1807.7261	156.5977	4705.0508
7	4.6162	1042.7681	64.7544	723.0811	407.9739	156.5977	14.2348	409.1372
8	170.7781	30562.2500	1838.4111	20938.6602	12019.7305	4705.0508	409.1372	12870.6250
9	-49.8305	-5065.3750	-301.1541	-3363.2852	-2073.3232	-728.9573	-63.0308	-2107.9050
10	248.7532	18745.9023	1257.2722	12591.4258	8287.5508	2432.7007	199.1652	5956.0156
11	579.0955	41756.5352	2859.4751	28001.6719	19058.5195	5318.2070	435.3271	12589.0000
12	24.6404	1048.8823	73.1630	667.5564	537.5193	122.2375	7.9486	295.2881
13	4.9205	654.0454	41.3899	447.7600	267.5171	94.6525	8.2913	244.4301
14	8.8223	1208.5295	76.8584	828.8970	494.3938	174.8114	15.2549	446.9517
15	0.8844	81.3655	5.4315	55.3651	34.9955	10.8275	0.9287	26.6393

ROW	COL. 9	COL. 10	COL. 11	COL. 12	COL. 13	COL. 14	COL. 15	COL.
1	-49.8305	248.7532	579.0955	24.6404	4.9205	8.8223	0.8844	
2	-5065.3750	18745.9023	41756.5352	1048.8823	654.0454	1208.5295	81.3655	
3	-301.1541	1257.2722	2859.4751	73.1630	41.3899	76.8584	5.4315	
4	-3363.2852	12591.4258	28001.6719	667.5564	447.7600	828.8970	55.3651	
5	-2073.3232	8287.5508	19058.5195	537.5193	267.5171	494.3938	34.9955	
6	-728.9573	2432.7007	5318.2070	122.2375	94.6525	174.8114	10.8275	
7	-63.0308	199.1652	435.3271	7.9486	8.2913	15.2549	0.9287	
8	-2107.9050	5956.0156	12589.0000	295.2881	244.4301	446.9517	26.6393	
9	567.6201	-1067.5334	-2110.5012	-72.2677	-40.6113	-70.1097	-4.4496	
10	-1067.5334	4222.0547	9378.4180	271.1335	131.9782	243.6016	17.5810	
11	-2110.5012	9378.4180	21679.5273	616.3440	289.6055	538.0461	39.5492	
12	-72.2677	271.1335	616.3440	26.3450	6.7506	12.1422	1.0064	
13	-40.6113	131.9782	289.6055	6.7506	5.0517	9.2458	0.5889	
14	-70.1097	243.6016	538.0461	12.1422	9.2458	17.1548	1.0845	
15	-4.4496	17.5810	39.5492	1.0064	0.5889	1.0845	0.0779	

CORRELATION MATRIX FOR BASIC DATA

ROW	COL. 1	COL. 2	COL. 3	COL. 4	COL. 5	COL. 6	COL. 7	COL. 8
1	1.0000	0.5652	0.6430	0.5131	0.7106	0.3728	0.2311	0.2843
2	0.5652	1.0000	0.9833	0.9967	0.9686	0.9632	0.9274	0.9039
3	0.6430	0.9833	1.0000	0.9783	0.9798	0.9081	0.8674	0.8190
4	0.5131	0.9967	0.9783	1.0000	0.9507	0.9693	0.9444	0.9095
5	0.7106	0.9686	0.9798	0.9507	1.0000	0.8880	0.8264	0.8097
6	0.3728	0.9632	0.9081	0.9693	0.8880	1.0000	0.9762	0.9754
7	0.2311	0.9274	0.8674	0.9444	0.8264	0.9762	1.0000	0.9559
8	0.2843	0.9039	0.8190	0.9095	0.8097	0.9754	0.9559	1.0000
9	-0.3950	-0.7134	-0.6388	-0.6956	-0.6651	-0.7196	-0.7012	-0.7799
10	0.7230	0.9680	0.9779	0.9549	0.9748	0.8806	0.8125	0.8080
11	0.7427	0.9516	0.9815	0.9371	0.9893	0.8495	0.7836	0.7536
12	0.9066	0.6857	0.7204	0.6409	0.8004	0.5601	0.4105	0.5071
13	0.4134	0.9764	0.9307	0.9817	0.9097	0.9905	0.9778	0.9586
14	0.4023	0.9791	0.9378	0.9862	0.9123	0.9927	0.9762	0.9512
15	0.5985	0.9784	0.9837	0.9777	0.9585	0.9126	0.8821	0.8415

ROW	COL. 9	COL. 10	COL. 11	COL. 12	COL. 13	COL. 14	COL. 15	COL.
1	-0.3950	0.7230	0.7427	0.9066	0.4134	0.4023	0.5985	
2	-0.7134	0.9680	0.9516	0.6857	0.9764	0.9791	0.9784	
3	-0.6388	0.9779	0.9815	0.7204	0.9307	0.9378	0.9837	
4	-0.6956	0.9549	0.9371	0.6409	0.9817	0.9862	0.9777	
5	-0.6651	0.9748	0.9893	0.8004	0.9097	0.9123	0.9585	
6	-0.7196	0.8806	0.8495	0.5601	0.9905	0.9927	0.9126	
7	-0.7012	0.8125	0.7836	0.4105	0.9778	0.9762	0.8821	
8	-0.7799	0.8080	0.7536	0.5071	0.9586	0.9512	0.8415	
9	1.0000	-0.6896	-0.6016	-0.5910	-0.7584	-0.7105	-0.6693	
10	-0.6896	1.0000	0.9803	0.8130	0.9037	0.9052	0.9697	
11	-0.6016	0.9803	1.0000	0.8155	0.8751	0.8823	0.9626	
12	-0.5910	0.8130	0.8155	1.0000	0.5852	0.5712	0.7027	
13	-0.7584	0.9037	0.8751	0.5852	1.0000	0.9932	0.9389	
14	-0.7105	0.9052	0.8823	0.5712	0.9932	1.0000	0.9384	
15	-0.6693	0.9697	0.9626	0.7027	0.9389	0.9384	1.0000	

BMD02D CORRELATION WITH TRANSGENERATION - REVISED JANUARY 29, 1970
HEALTH SCIENCES COMPUTING FACILITY,UCLA

PROBLEM CODE BMD02D
NUMBER OF VARIABLES 15
NUMBER OF CASES 18

VARIABLE FORMAT CARD (S)
(10F8.3)

REMAINING SAMPLE SIZE= 18 , COMPOSITION DATA

SUMS

	91.2319	13356.1953	200.9919	1514.0903	321.4246	1255.1992	469.8994	2718.6995
	159.8039	84.9369	394.1064	113.1509	5.7340	34.4049	0.7980	

MEANS

	5.0684	742.0107	11.1662	84.1161	17.8569	69.7333	26.1055	151.0388
	8.8780	4.7187	21.8948	6.2862	0.3186	1.9114	0.0443	

CROSS PRODUCT DEVIATIONS

ROW	COL. 1	COL. 2	COL. 3	COL. 4	COL. 5	COL. 6	COL. 7	COL. 8
1	57.4385	-7186.1445	51.2653	98.3696	-127.9321	-1155.3884	-110.5205	-3024.6997
2	-7186.1445	1509960.0000	-7764.5977	-23884.3906	34671.8438	207482.2500	17727.0586	519558.3125
3	51.2653	-7764.5977	53.4008	128.4395	-158.2336	-1214.1492	-109.8788	-3283.0447
4	98.3696	-23884.3906	128.4395	467.3169	-617.0601	-3310.2444	-272.8110	-8628.7109
5	-127.9321	34671.8438	-158.2336	-617.0601	968.9641	4571.8516	370.0803	11156.3594
6	-1155.3884	207482.2500	-1214.1492	-3310.2444	4571.8516	30731.3438	2662.1611	79985.8750
7	-110.5205	17727.0586	-109.8788	-272.8110	370.0803	2662.1611	241.9920	6955.3359
8	-3024.6997	519558.3125	-3283.0447	-8628.7109	11156.3594	79985.8750	6955.3359	218800.6875
9	123.7772	-23084.3789	145.4701	419.6685	-499.1587	-3406.9263	-306.4890	-9529.7539
10	-94.6634	23082.6367	-111.5732	-379.7908	556.5779	3118.7041	257.3328	7881.6836
11	-95.8569	32860.6484	-116.4342	-519.8708	943.5649	4012.5083	309.2729	8959.7266
12	64.4672	-8693.9648	58.7202	123.9676	-160.5481	-1343.9622	-127.8161	-3447.1177
13	-5.3478	734.2705	-5.1851	-11.2307	14.2710	118.1427	11.0950	317.8843
14	2.1304	-734.7036	3.0280	13.4391	-19.2853	-89.7289	-7.2838	-217.9637
15	-0.3936	70.4408	-0.3730	-0.9717	1.4768	9.8109	0.8976	24.5142

ROW	COL. 9	COL. 10	COL. 11	COL. 12	COL. 13	COL. 14	COL. 15	COL.
1	123.7772	-94.6634	-95.8569	64.4672	-5.3478	2.1304	-0.3936	
2	-23084.3789	23082.6367	32860.6484	-8693.9648	734.2705	-734.7036	70.4408	
3	145.4701	-111.5732	-116.4342	58.7202	-5.1851	3.0280	-0.3730	
4	419.6685	-379.7908	-519.8708	123.9676	-11.2307	13.4391	-0.9717	
5	-499.1587	556.5779	943.5649	-160.5481	14.2710	-19.2853	1.4768	
6	-3406.9263	3118.7041	4012.5083	-1343.9622	118.1427	-89.7289	9.8109	
7	-306.4890	257.3328	309.2729	-127.8161	11.0950	-7.2838	0.8976	
8	-9529.7539	7881.6836	8959.7266	-3447.1177	317.8843	-217.9637	24.5142	
9	529.6558	-360.7185	-354.6121	143.6385	-14.1370	11.2373	-1.0739	
10	-360.7185	369.4739	538.5747	-115.1640	10.3222	-12.0106	1.0421	
11	-354.6121	538.5747	1057.1575	-124.3523	10.3213	-18.9163	1.4694	
12	143.6385	-115.1640	-124.3523	75.0012	-6.0417	3.0630	-0.4616	
13	-14.1370	10.3222	10.3213	-6.0417	0.5450	-0.2612	0.0387	
14	11.2373	-12.0106	-18.9163	3.0630	-0.2612	0.5022	-0.0326	
15	-1.0739	1.0421	1.4694	-0.4616	0.0387	-0.0326	0.0041	

STANDARD DEVIATIONS

	1.8381	298.0288	1.7723	5.2430	7.5497	42.5174	3.7729	113.4488
	5.5818	4.6619	7.8958	2.1004	0.1791	0.1719	0.0156	

VARIANCE-COVARIANCE MATRIX FOR COMPOSITION DATA

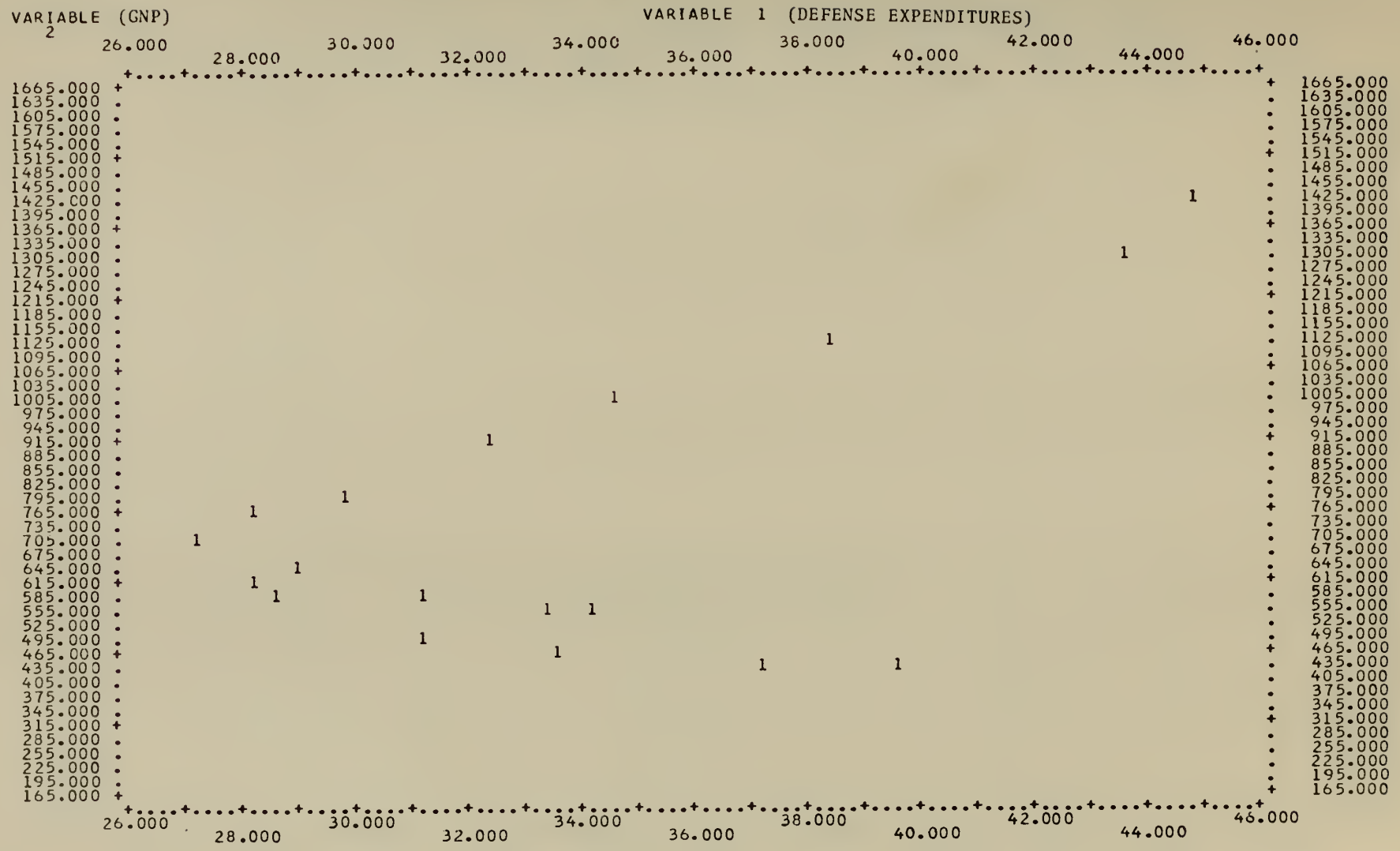
ROW	COL. 1	COL. 2	COL. 3	COL. 4	COL. 5	COL. 6	COL. 7	COL. 8
1	3.3787	-422.7144	3.0156	5.7864	-7.5254	-67.9640	-6.5012	-177.9235
2	-422.7144	88621.1250	-456.7410	-1404.9641	2039.5200	12204.8359	1042.7681	30562.2500
3	3.0156	-456.7410	3.1412	7.5553	-9.3079	-71.4205	-6.4635	-193.1203
4	5.7864	-1404.9641	7.5553	27.4892	-36.2976	-194.7202	-16.0477	-507.5710
5	-7.5254	2039.5200	-9.3079	-36.2976	56.9979	268.9324	21.7694	656.2563
6	-67.9640	12204.8359	-71.4205	-194.7202	268.9324	1807.7261	156.5977	4705.0508
7	-6.5012	1042.7681	-6.4635	-16.0477	21.7694	156.5977	14.2348	409.1372
8	-177.9235	30562.2500	-193.1203	-507.5710	656.2563	4705.0508	409.1372	12870.6250
9	7.2810	-1357.9045	8.5571	24.6864	-29.3623	-200.4074	-18.0288	-560.5737
10	-5.5684	1357.8020	-6.5631	-22.3406	32.7399	183.4532	15.1372	463.6284
11	-5.6386	1932.9792	-6.8491	-30.5806	55.5038	236.0299	18.1925	527.0427
12	3.7922	-511.4097	3.4541	7.2922	-9.4440	-79.0566	-7.5186	-202.7716
13	-0.3146	43.1924	-0.3050	-0.6606	0.8395	6.9496	0.6526	18.6991
14	0.1253	-43.2178	0.1781	0.7905	-1.1344	-5.2782	-0.4285	-12.8214
15	-0.0232	4.1436	-0.0219	-0.0572	0.0869	0.5771	0.0528	1.4420

ROW	COL. 9	COL. 10	COL. 11	COL. 12	COL. 13	COL. 14	COL. 15	COL.
1	7.2810	-5.5684	-5.6386	3.7922	-0.3146	0.1253	-0.0232	
2	-1357.9045	1357.8020	1932.9792	-511.4097	43.1924	-43.2178	4.1436	
3	8.5571	-6.5631	-6.8491	3.4541	-0.3050	0.1781	-0.0219	
4	24.6864	-22.3406	-30.5806	7.2922	-0.6606	0.7905	-0.0572	
5	-29.3623	32.7399	55.5038	-9.4440	0.8395	-1.1344	0.0869	
6	-200.4074	183.4532	236.0299	-79.0566	6.9496	-5.2782	0.5771	
7	-18.0288	15.1372	18.1925	-7.5186	0.6526	-0.4285	0.0528	
8	-560.5737	463.6284	527.0427	-202.7716	18.6991	-12.8214	1.4420	
9	31.1562	-21.2187	-20.8595	8.4493	-0.8316	0.6610	-0.0632	
10	-21.2187	21.7337	31.6809	-6.7744	0.6072	-0.7065	0.0613	
11	-20.8595	31.6809	62.1857	-7.3148	0.6071	-1.1127	0.0864	
12	8.4493	-6.7744	-7.3148	4.4118	-0.3554	0.1802	-0.0272	
13	-0.8316	0.6072	0.6071	-0.3554	0.0321	-0.0154	0.0023	
14	0.6610	-0.7065	-1.1127	0.1802	-0.0154	0.0295	-0.0019	
15	-0.0632	0.0613	0.0864	-0.0272	0.0023	-0.0019	0.0002	

CORRELATION MATRIX FOR COMPOSITION DATA

ROW	COL. 1	COL. 2	COL. 3	COL. 4	COL. 5	COL. 6	COL. 7	COL. 8
1	1.0000	-0.7716	0.9257	0.6004	-0.5423	-0.8696	-0.9374	-0.8532
2	-0.7716	1.0000	-0.8647	-0.8991	0.9064	0.9632	0.9274	0.9039
3	0.9257	-0.8647	1.0000	0.8131	-0.6956	-0.9478	-0.9666	-0.9605
4	0.6004	-0.8991	0.8131	1.0000	-0.9170	-0.8735	-0.8113	-0.8533
5	-0.5423	0.9064	-0.6956	-0.9170	1.0000	0.8378	0.7643	0.7662
6	-0.8696	0.9632	-0.9478	-0.8735	0.8378	1.0000	0.9762	0.9754
7	-0.9374	0.9274	-0.9666	-0.8113	0.7643	0.9762	1.0000	0.9559
8	-0.8532	0.9039	-0.9605	-0.8533	0.7662	0.9754	0.9559	1.0000
9	0.7096	-0.8163	0.8650	0.8435	-0.6968	-0.8445	-0.8561	-0.8852
10	-0.6498	0.9773	-0.7943	-0.9140	0.9302	0.9255	0.8606	0.8766
11	-0.3890	0.8225	-0.4900	-0.7396	0.9323	0.7040	0.6115	0.5891
12	0.9822	-0.8170	0.9279	0.6622	-0.5955	-0.8852	-0.9487	-0.8509
13	-0.9558	0.8094	-0.9611	-0.7037	0.6210	0.9129	0.9661	0.9205
14	0.3967	-0.8437	0.5847	0.8773	-0.8742	-0.7223	-0.6607	-0.6575
15	-0.8062	0.8899	-0.7924	-0.6978	0.7365	0.8687	0.8957	0.8135

ROW	COL. 9	COL. 10	COL. 11	COL. 12	COL. 13	COL. 14	COL. 15	COL.
1	0.7096	-0.6498	-0.3890	0.9822	-0.9558	0.3967	-0.8062	
2	-0.8163	0.9773	0.8225	-0.8170	0.8094	-0.8437	0.8899	
3	0.8650	-0.7943	-0.4900	0.9279	-0.9611	0.5847	-0.7924	
4	0.8435	-0.9140	-0.7396	0.6622	-0.7037	0.8773	-0.6978	
5	-0.6968	0.9302	0.9323	-0.5955	0.6210	-0.8742	0.7365	
6	-0.8445	0.9255	0.7040	-0.8852	0.9129	-0.7223	0.8687	
7	-0.8561	0.8606	0.6115	-0.9487	0.9661	-0.6607	0.8957	
8	-0.8852	0.8766	0.5891	-0.8509	0.9205	-0.6575	0.8135	
9	1.0000	-0.8154	-0.4739	0.7207	-0.8321	0.6890	-0.7243	
10	-0.8154	1.0000	0.8618	-0.6918	0.7274	-0.8817	0.8416	
11	-0.4739	0.8618	1.0000	-0.4416	0.4300	-0.8210	0.7015	
12	0.7207	-0.6918	-0.4416	1.0000	-0.9450	0.4991	-0.8273	
13	-0.8321	0.7274	0.4300	-0.9450	1.0000	-0.4992	0.8136	
14	0.6890	-0.8817	-0.8210	0.4991	-0.4992	1.0000	-0.7130	
15	-0.7243	0.8416	0.7015	-0.8273	0.8136	-0.7130	1.0000	


VARIABLE (GNP)
2
VARIABLE 1 (DEFENSE EXPENDITURES)
26.000
28.000
30.000
32.000
34.000
36.000
38.000
40.000
42.000
44.000
46.000
1665.000
1635.000
1605.000
1575.000
1545.000
1515.000
1485.000
1455.000
1425.000
1395.000
1365.000
1335.000
1305.000
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945.000
915.000
885.000
855.000
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795.000
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675.000
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615.000
585.000
555.000
525.000
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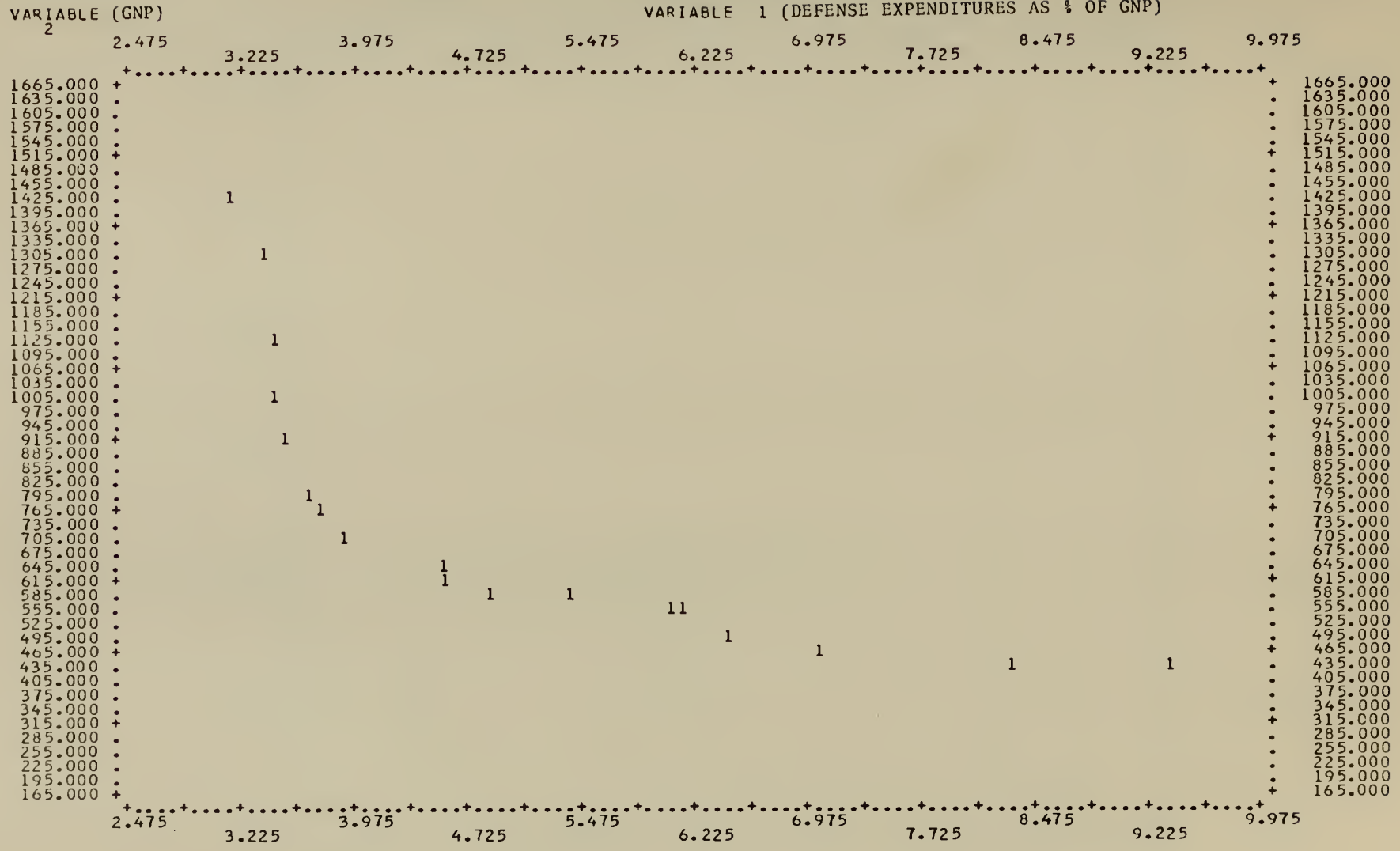
VARIABLE (GNP)
2
VARIABLE 1 (DEFENSE EXPENDITURES AS % OF GNP)
2.475
3.225
3.975
4.725
5.475
6.225
6.975
7.725
8.475
9.225
9.975
1665.000
1635.000
1605.000
1575.000
1545.000
1515.000
1485.000
1455.000
1425.000
1395.000
1365.000
1335.000
1305.000
1275.000
1245.000
1215.000
1185.000
1155.000
1125.000
1095.000
1065.000
1035.000
1005.000
975.000
945.000
915.000
885.000
855.000
825.000
795.000
765.000
735.000
705.000
675.000
645.000
615.000
585.000
555.000
525.000
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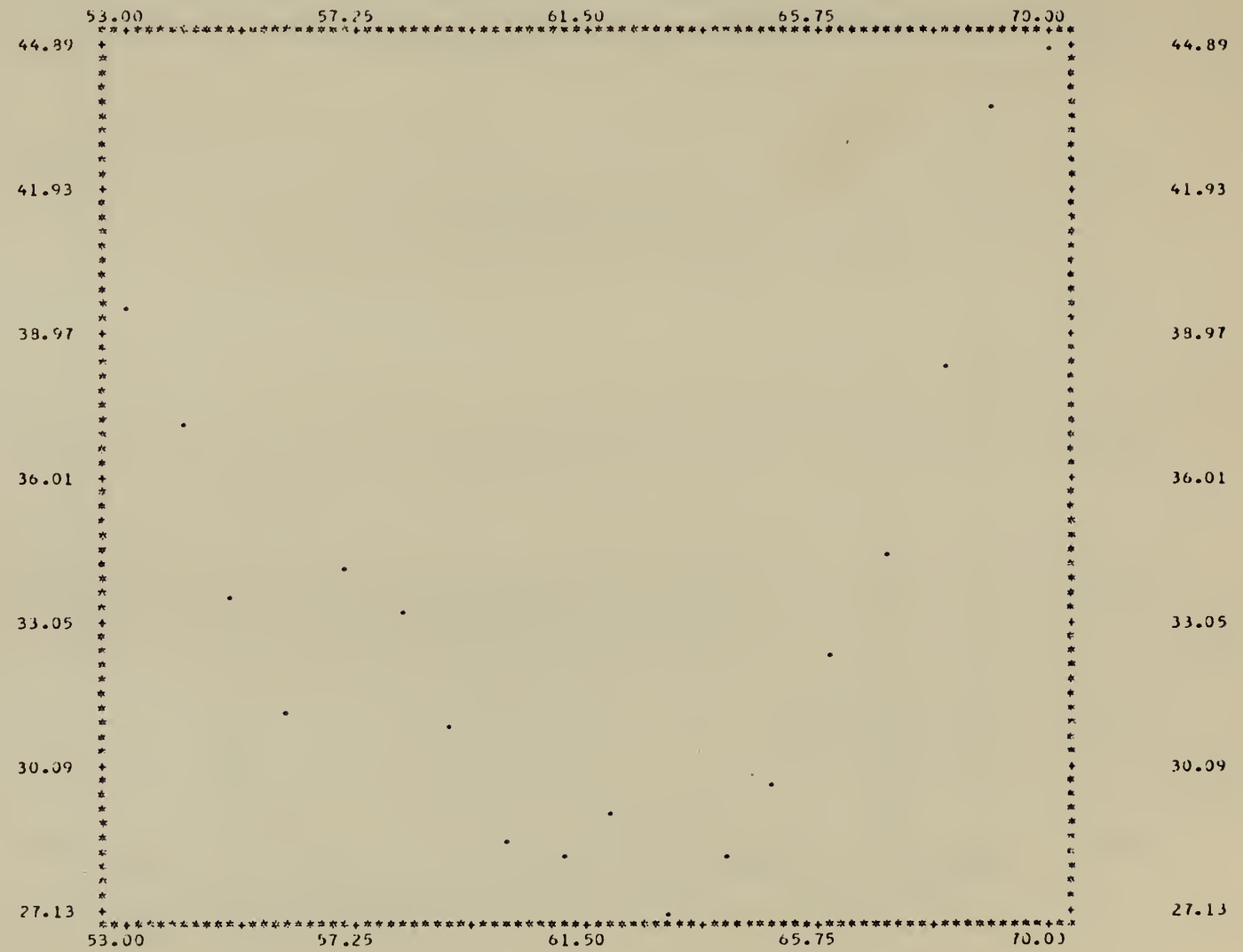
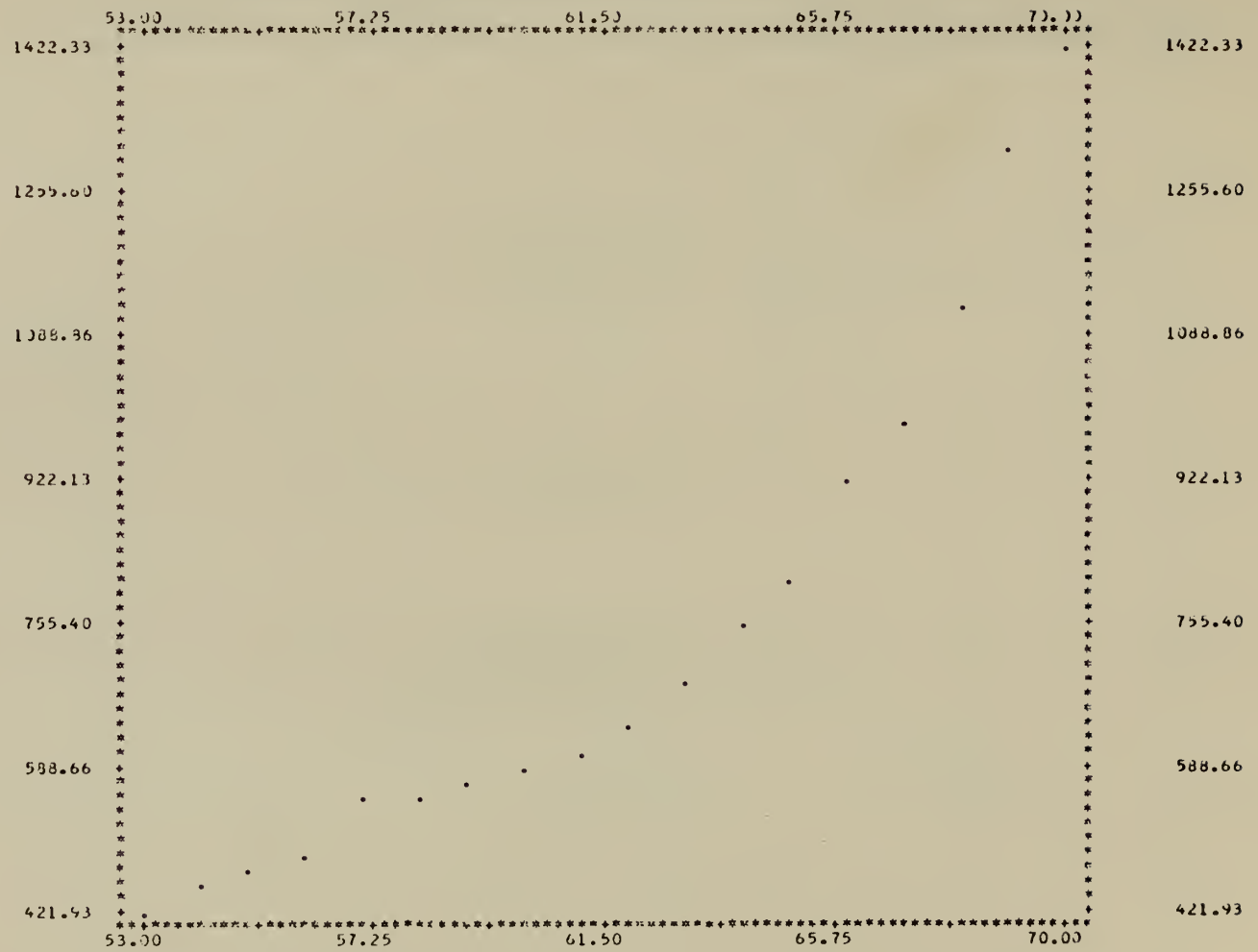
315.000
285.000
255.000
225.000
195.000
165.000


VARIABLE 1 OF BASIC DATA (DEFENSE EXPENDITURES vs. YEAR)
53.00
57.25
61.50
65.75
70.00
44.89
41.93
38.97
36.01
33.05
30.09
27.13
X-SCALE: "*"= 0.212E 00 UNITS
Y-SCALE: "*"= 0.296E 00 UNITS

VARIABLE 2 OF BASIC DATA (GNP vs. YEAR)



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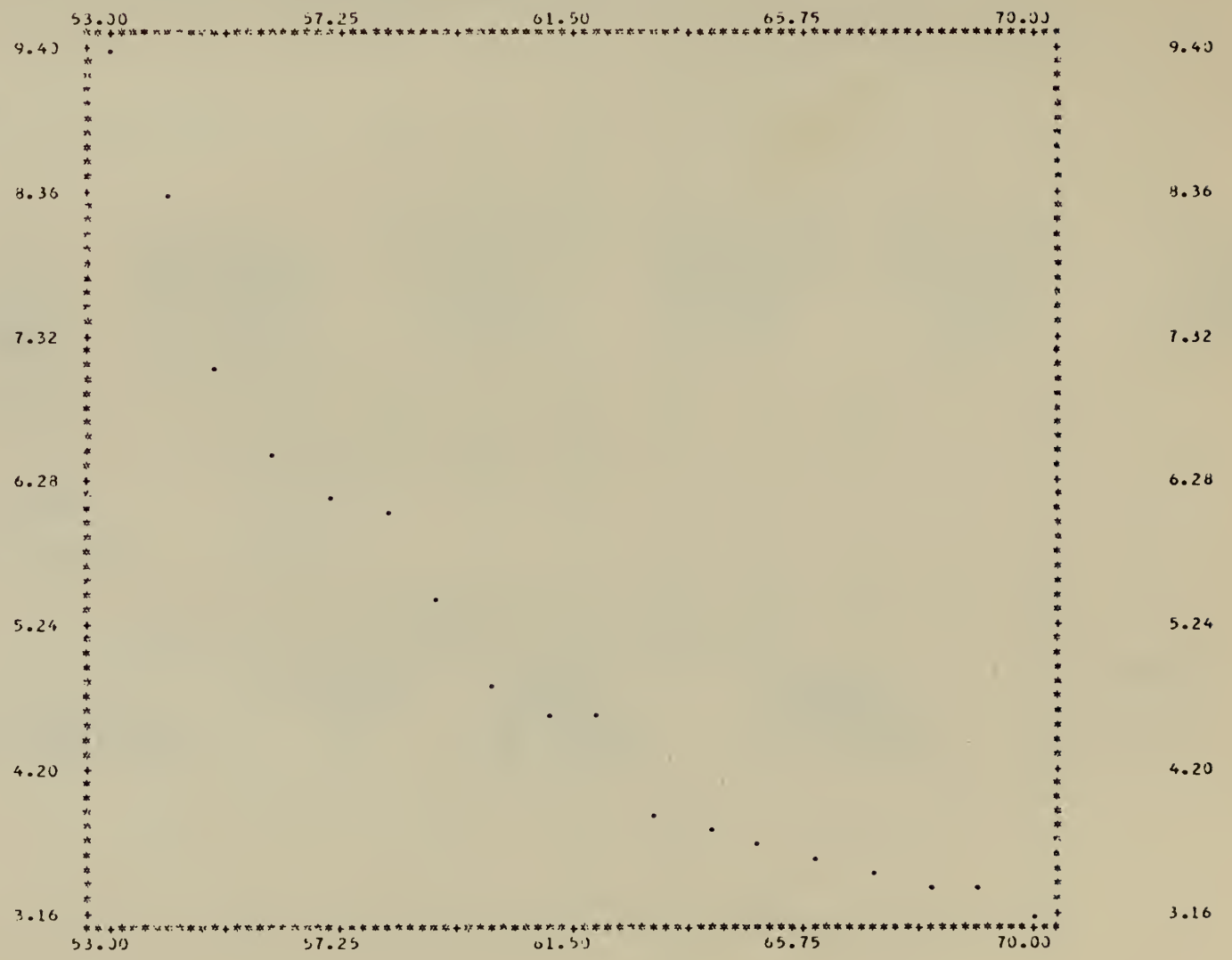
Y-SCALE: "*"= 0.167E 02 UNITS


VARIABLE 1 OF COMPOSITION DATA (DEFENSE EXPENDITURES AS % OF GNP vs. YEAR)
53.00
57.25
61.50
65.75
70.00
9.40
8.36
7.32
6.28
5.24
4.20
3.16
X-SCALE: "*"= 0.212E 00 UNITS
Y-SCALE: "*"= 0.104E 00 UNITS

MULTIPLE REGRESSION.....ORIGIN

SELECTION..... 3

VARIABLE NO.	MEAN	STANDARD DEVIATION	CORRELATION X VS Y	REGRESSION COEFFICIENT	STD. ERROR OF REG.COEF.	COMPUTED T VALUE
2	742.01074	298.02808	0.56521	0.10239	0.04488	2.28119
3	78.54155	19.78717	0.64301	0.63821	0.22884	2.78838
4	610.88232	202.93341	0.51309	-0.19297	0.05833	-3.30821
5	151.76271	130.84129	0.71059	-0.00717	0.03680	-0.19496
DEPENDENT 1	33.61548	5.29526				

INTERCEPT	26.48509
MULTIPLE CORRELATION	0.93286
STD. ERROR OF ESTIMATE	2.18139

ANALYSIS OF VARIANCE FOR THE REGRESSION

SOURCE OF VARIATION	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARES	F VALUE
ATTRIBUTABLE TO REGRESSION	4	414.81714	103.70428	21.79370
DEVIATION FROM REGRESSION	13	61.85986	4.75845	
TOTAL	17	476.67700		

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13. ABSTRACT

The huge size of the Korean defense budget and its armed forces have created a need for an operational analysis. It is shown through a multivariate statistical analysis what some of the opportunity costs of defense spending have been.

The Korea-U. S. alliance is discussed emphasizing developmental effects of U. S. aid.

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14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
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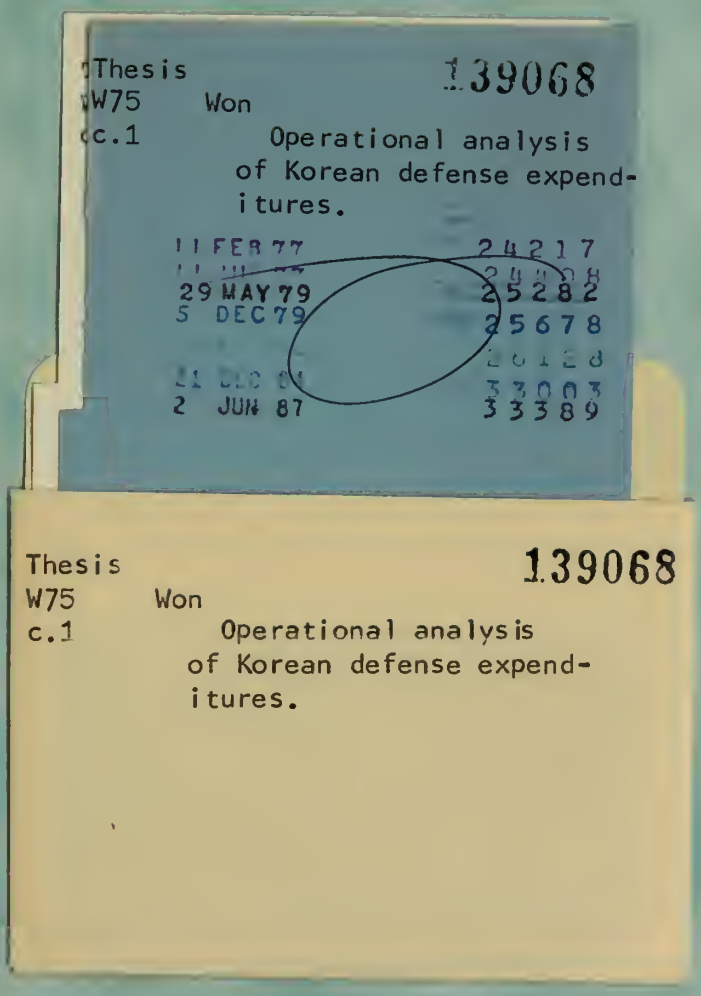

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W75 Won
c.1 Operational analysis
of Korean defense expend-
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